UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

Refer to:
OSB2001-0056-FEC

November 16, 2001

Mr. Lawrence C. Evans
Portland District, Corps of Engineers
CENWP-OP-GP (Monical)
P.O. Box 2946
Portland, Oregon 97208-2946

Re: Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Act Essential Fish Habitat Consultation, West Mooring Basin Breakwater Reconstruction Project, Lower Columbia River Basin, Clatsop County, Oregon (Corps No. 2001-00353)

Dear Mr. Evans:

Enclosed is a biological opinion (Opinion) prepared by the National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act (ESA) on the effects of the proposed West Mooring Basin Breakwater Reconstruction Project in Clatsop County, Oregon. In this Opinion, NMFS concludes that the proposed action is not likely to jeopardize the continued existence of twelve ESA-listed salmonids, or destroy or adversely modify their designated critical habitat. As required by section 7 of the ESA, NMFS included reasonable and prudent measures with nondiscretionary terms and conditions that NMFS believes are necessary to minimize the impact of incidental take associated with this action.

This Opinion also serves as consultation on Essential Fish Habitat pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations at 50 CFR Part 600.

Please direct any questions regarding this consultation to Rob Markle of my staff in the Oregon Habitat Branch at 503.230.5419

Sincerely,

Michael R Crouse
f.c
D. Robert Lohn
Regional Administrator

Endangered Species Act
Section 7 Consultation
and
Magnuson-Stevens Act
Essential Fish Habitat Consultation

BIOLOGICAL OPINION

West Mooring Basin Breakwater Reconstruction Project,
Lower Columbia River Basin, Clatsop County, Oregon (Corps No. 2001-00353)

Agency: U.S. Army Corps of Engineers, Portland District

Consultation Conducted by: National Marine Fisheries Service,
Northwest Region

Date Issued: November 16, 2001

F.r Michael R Crouse

D. Robert Lohn
Regional Administrator

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1. ENDANGERED SPECIES ACT

1.1 Background

On July 18, 2001, the National Marine Fisheries Service (NMFS) received a letter from the U.S. Army Corps of Engineers (Corps) requesting formal consultation pursuant to the Endangered Species Act (ESA) for the issuance of a permit under section 10 of the Rivers and Harbors Act and section 404 of the Clean Water Act to the Port of Astoria to reconstruct a breakwater at the West Mooring Basin on the Columbia River, Clatsop County, Oregon. The Corps submitted a biological assessment (BA) and sediment test results describing the proposed action and potential effects that may result from project implementation with the letter. In the BA the Corps determined the proposed action was likely to adversely affect the following ESA listed species: Snake River steelhead (*Oncorhynchus mykiss*), Upper Columbia River steelhead, Middle Columbia River steelhead, Upper Willamette River steelhead, Lower Columbia River steelhead, Snake River spring/summer chinook salmon (*O. tshawytscha*), Snake River fall chinook salmon, Upper Columbia River spring-run chinook salmon, Upper Willamette River chinook salmon, Lower Columbia River chinook salmon, Columbia River chum salmon (*O. keta*), and Snake River sockeye salmon (*O. nerka*).

On July 27, 2001, the NMFS requested additional information on the proposed action to assist in the evaluation of effects on listed species. The Corps provided the last of the requested information (validity of sediment sample sites) to NMFS on October 9, 2001.

The purpose of the proposed project is to maintain wave-action protection for the commercial fishing and recreational vessels using the West Mooring Basin (Mooring Basin). The existing timber and rock breakwater was constructed in 1936 and is failing. The Mooring Basin is on the Columbia River at approximately river-mile 13, and is adjacent to the Highway 101 Astoria Bridge.

This biological opinion (Opinion) considers the potential effects of the proposed action on Snake River steelhead, Upper Columbia River steelhead, Middle Columbia River steelhead, Upper Willamette River steelhead, Lower Columbia River steelhead, Snake River spring/summer chinook salmon, Snake River fall chinook salmon, Upper Columbia River spring-run chinook salmon, Upper Willamette River chinook salmon, Lower Columbia River chinook salmon, Columbia River chum salmon, and Snake River sockeye salmon. The subject action will occur within designated critical habitat for these species. Species information references, listing dates, critical habitat designations, and take prohibitions are listed in Table 1. The objective of this Opinion is to determine whether the proposed action is likely to jeopardize the continued existence of the ESA listed species, or destroy or adversely modify designated critical habitat for this species. This consultation is conducted pursuant to section 7(a)(2) of the ESA and its implementing regulations, 50 CFR 402.

1.2 Proposed Action

The proposed action is issuance of a permit by the Corps under section 10 of the Rivers and Harbors Act and section 404 of the Clean Water Act for breakwater reconstruction at river-mile 13 of the Columbia River. The Port of Astoria (permit applicant) proposes to replace the existing breakwater, a rock-filled timber bulkhead, with an all steel structure. Approximately 73 steel piles (30-inch diameter) with interlocking sheet-pile wings will be driven. The pile tops will be cut to form a level top-line to which a steel pile cap connecting all the piles will be welded. The sheet pile will extend to a depth of 0.0 feet mean lower low water (MLLW). The new structure will be 420 feet long, approximately 3 feet wide, and river-ward of the existing breakwater.

After constructing the new breakwater, the applicant proposes to remove the existing breakwater. Existing steel and treated wood piles will be removed using a vibratory hammer. Any piles that cannot be extracted will be excavated and removed. The applicant will dispose of all removed materials in a suitable upland location.

An approximately 1.25 acre area will be dredged to a depth of -14 feet MLLW around the new structure using an hydraulic-pipeline dredge. Dredging will create a 14-foot gap beneath the sheet-pile wall. The new design is expected to increase the exchange of water between the main channel and the basin. An estimated 19,000 cubic yards of material will be removed and piped to the Columbia River flow lane for disposal at approximately river mile 13. Sediment testing conducted in 1997 indicated that dredged materials were suitable for unconfined in-water disposal as determined at the time by the Dredge Material Management Team (DMMT). The DMMT is composed of the Corps, Oregon Department of Environmental Quality, and the United States Environmental Protection Agency. The disposal pipeline will discharge dredge material at a depth of approximately 35 feet, or 5 feet to 10 feet above the river bottom during ebb tides. The Corps does not know how far the turbidity plume will extend since the sediment test results indicated a high fine particle content (56.3% to 98.4% silt/clay) and the Corps has primarily studied coarse particle behavior in shallow water habitat.[1]

The proposed action will take approximately 3 months to complete, including approximately 30 days of dredging. All in-water work is proposed to occur during the Oregon Department of Fish and Wildlife (ODFW) recommended in-water work window, November 1 to February 28 (ODFW 2000). A barge will be used in association with this action.

1.3 Biological Information and Critical Habitat

Based on migratory timing, listed salmon or steelhead species likely will be present in the action area during the proposed dredging operations. The proposed action would occur within designated critical habitat for the listed salmon species.

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[1] Telephone conversation with T. Monical, U.S. Army Corps of Engineers, discussing project design and construction methods (July 31, 2001).

An action area is defined by NMFS regulations (50 CFR Part 402) as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." Direct effects occur at the project site and may extend upstream or downstream based on the potential for impairing fish passage, hydraulics, sediment and pollutant discharge, and the extent of riparian habitat modifications. Indirect affects may occur throughout the watershed where actions described in this Opinion lead to additional activities or affect ecological functions contributing to stream degradation.

For this project, NMFS defines the action area as the affected substrate, bank, and aquatic areas of the Columbia River at the 1.25 acre project site, and a distance not to exceed 3-miles downstream of river-mile 13 due to dredge material disposal. The action area serves predominately as a migration corridor for both adult and juvenile salmonids. Peak juvenile migration periods are May through June for steelhead, sockeye salmon, coho salmon (*O. kisutch*), and age-1 chinook salmon juveniles, and June through July for age-0 chinook juveniles. The peak chum salmon fry outmigration occurs from March through May. Juvenile salmonids may reside in the Columbia River estuary year round, but most species spend no more than a few months in the estuary before emigrating to the ocean to mature. Age-0 (fall) chinook salmon are more dependent on the estuary than other species. Returning adults migrate over a wide range of times depending on species and stock of origin. Steelhead, chum salmon and coho salmon are the primary adult salmonids likely to be present during the proposed in-water work period (November 1 to February 28). Coho salmon are currently a candidate species for ESA listing. For specific species information, refer to the literature cited in Table 1.

The mainstem portions of rivers in Oregon serve as an important migration route for numerous species of anadromous fish, and may favor either shallow, nearshore habitats like fall chinook or mid-river channel like sockeye salmon and steelhead juveniles (Dawley *et al*. 1986). The addition of in-water structures and upland facilities may affect anadromous fish through creation of predatory fish habitat or changes in water quality from marina related sources or upland run-off.

Juveniles of salmonid species such as spring chinook, sockeye, and coho salmon and steelhead usually move down river relatively quickly and in the main channel. This aids in predator avoidance (Gray and Rondorf 1986). Fall and summer chinook salmon are found in nearshore, littoral habitats and are particularly vulnerable to predation (Gray and Rondorf 1986). Juvenile salmonids (chinook and coho salmon) use backwater areas during their outmigration (Parente and Smith 1981).

Essential features of the adult and juvenile migratory corridor for the species are: (1) Substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food (primarily juvenile), (8) riparian vegetation, (9) space, and (10) safe passage conditions. The essential features this proposed project may affect are substrate, water quality, food, and safe passage conditions resulting from dredging and dredge disposal activities.

1.4 Evaluating Proposed Actions

The standards for determining jeopardy are set forth in section 7(a)(2) of the ESA as defined by 50 CFR Part 402 (the consultation regulations). In conducting analyses of habitat-altering actions under section 7 of the ESA, NMFS uses the following steps: (1) Consider the status and biological requirements of the species; (2) evaluate the relevance of the environmental baseline in the action area to the species' current status; (3) determine the effects of the proposed or continuing action on the species; (4) consider cumulative effects; and (5) determine whether the proposed action, in light of the above factors, is likely to appreciably reduce the likelihood of species survival in the wild or adversely modify its critical habitat. In completing this step of the analysis, NMFS determines whether the action under consultation, together with all cumulative effects when added to the environmental baseline, is likely to jeopardize the continued existence of the listed species or result in destruction, adversely modify their critical habitat, or both. If NMFS finds that the action is likely to jeopardize the listed species, NMFS must identify reasonable and prudent alternatives for the action.

1.4.1 Biological Requirements

The first step in the methods NMFS uses for applying the ESA to listed species is to define the biological requirements of the species most relevant to each consultation. NMFS also considers the current status of the listed species taking into account population size, trends, distribution and genetic diversity. To assess the current status of the listed species, NMFS starts with the determinations made in its decision to list the species for ESA protection and also considers new data available that are relevant to the determination.

The relevant biological requirements are those necessary for the listed species to survive and recover to naturally reproducing population levels at which protection under the ESA would become unnecessary. Adequate population levels must safeguard the genetic diversity of the listed stocks, enhance their capacity to adapt to various environmental conditions, and allow them to become self-sustaining in the natural environment.

The biological requirements that are relevant to this consultation are adequate water quality, increased migration and spawning survival and improved habitat characteristics (including food availability and quality, and substrate composition) that function to support successful migration and rearing. The current status of the affected listed species, based upon their risk of extinction, has not significantly improved since these species were listed and, in some cases, their status may have worsened due to continuing downward trends toward extinction (see Table 1 for references).

1.4.2 Environmental Baseline

The environmental baseline is a review of the effects of past and ongoing human and natural factors leading to the current status of the species or its habitat and ecosystem within the action area.
The Columbia River below Bonneville Dam has been substantially altered due to diking of lowlands for flood prevention and agriculture, increased inputs of sewage and storm water run-off from cities, shoreline modification to prevent erosion, installation of docks and marinas, installation of berthing facilities and wharves for shipping, and dredging for vessel navigation. These alterations have modified water quality, altered rearing and spawning habitat, and decreased migration survival. The biological requirements of the listed species are currently not being met under the environmental baseline. Their status is such that there must be a significant improvement in the environmental conditions they experience, including the condition of designated critical habitat, over those currently available under the environmental baseline.

In addition to the subject consultation, the NMFS is aware of two dredging actions proposed in the area that will dispose of dredge material in the lower Columbia River. The East End Boat Basin Breakwater Repair Project Phase-3 will dispose of approximately 45,000 cubic yards of material at river mile 15. The East Mooring Basin Dredging Project proposes to dispose of 20,000 cubic yards of material at river mile 16.

1.5 Analysis of Effects

1.5.1 Effects of Proposed Actions

<u>In-Water Structures</u>
In-water structures may provide increased opportunities for salmonid predation. When a salmon stock suffers from low abundance, predation can contribute significantly to its extinction (Larkin 1979). Providing temporary respite from predation may contribute to increasing Pacific salmon (Larkin 1979). A substantial reduction in predators will generally result in an increase in prey abundance, in this case salmonids (Campbell 1979). In addition, the presence of predators may force smaller prey fish species into less desirable habitats, disrupting foraging behavior, resulting in less growth (Dunsmoor *et al*. 1991). In evaluating predation in the Columbia River Basin, Gray and Rondorf (1986) state that “The most effective management program may be to reduce the susceptibility of juvenile salmonids to predation by providing maximum protection during their downstream migration.” Campbell (1979), discussing management of large rivers and predator-prey relations, advocates that a “do nothing” approach (as opposed to predator manipulations) coupled with a strong habitat protectionist policy, should receive serious consideration.

There are four major predatory strategies used by piscivorous fish: They overtake prey; ambush prey; habituate prey to a non-aggressive illusion; or stalk prey (Hobson 1979). Ambush predation is probably the most common strategy. Under such a strategy predators lie-in-wait, then dart out at the prey in an explosive rush (Gerking 1994). Predators may use sheltered areas that provide slack water to ambush prey fish in faster currents (Bell 1991).

Light plays an important role in defense from predation. Prey species are better able to see predators under high light intensity, thus providing the prey species with an advantage (Hobson 1979, Helfman 1981). Predator success is higher at lower light intensities (Petersen and Gadomski 1994). Prey fish lose their ability to school at low light intensities, making them vulnerable to predation (Petersen and Gadomski 1994). Shade, in conjunction with water clarity, sunlight and vision, is a factor in attraction of temperate lake fishes to overhead structure (Helfman 1981). Over-water structures cause shadows and low light intensity conditions in the water column below or adjacent to the structures, which may benefit predator fish species to the detriment of prey species.

In addition to providing conditions favorable to piscivorous predators, in-water structures (tops of pilings) also provide perching platforms for avian predators such as double-crested cormorants (*Phalacrocorax auritis*), from which they can launch feeding forays. Their high energy demands associated with flying and swimming create a need for voracious predation on live prey (Ainley 1984). Cormorants are underwater pursuit swimmers (Harrison 1983) that typically feed on mid-water schooling fish (Ainley 1984), but they are known to be highly opportunistic feeders (Derby and Lovvorn 1997; Blackwell *et al*. 1997; Duffy 1995). Double-crested cormorants are known to fish cooperatively in shallow water areas, herding fish before them (Ainley 1984). Krohn *et al*. (1995) indicate that cormorants can reduce fish populations in forage areas, thus possibly affecting adult returns as a result of smolt consumption. Because their plumage becomes wet when diving, cormorants spend considerable time drying out feathers (Harrison 1983) on pilings and other structures near feeding grounds (Harrison 1984). Placement of piles to support in-water structures will potentially provide for some usage by cormorants. Placement of anti-perching devices on the top of the pilings would preclude their use by any potential avian predators.

An increase in piscivorous fish or bird predation likely will not result from the completion of the proposed action. While the proposed structure will result in water column shadow lines and provide avian perches, these features will not be increased relative to current site conditions, and may represent marginal improvements.

Breakwater Construction and Removal

The construction and maintenance of marinas can have direct and indirect affects on fish as a result of pile driving, design and materials (e.g., treated wood), water quality (e.g., turbidity and fuel contamination), and construction timing. Activities associated with pile driving have the potential to disrupt normal migration behavior. Salmonids can detect sound frequencies generated by pile driving within a radius of 984 feet (300 meters) (Feist *et al*. 1996), and may be displaced by pile driving. This behavioral response could delay fish migration, or displace fish to less preferred habitats. Furthermore, pile driving can increase suspension of sediments.

Suspended sediment and turbidity influences on fish reported in the literature range from beneficial to detrimental. Elevated total suspended solids (TSS) conditions have been reported to enhance cover conditions, reduce piscivorous fish/bird predation rates, and improve survival. Elevated TSS conditions have also been reported to cause physiological stress, reduce growth, and reduce survival. Of key importance in considering the detrimental effects of TSS on fish are the frequency and the duration of the exposure (not just the TSS concentration).

Behavioral avoidance of turbid waters may be one of the most important effects of elevated suspended sediments (DeVore *et al*. 1980, Birtwell *et al*. 1984, Scannell 1988). Salmonids have been observed to move laterally and downstream to avoid turbid plumes (McLeay *et al*. 1984, 1987, Sigler *et al*. 1984, Lloyd 1987, Scannell 1988, Servizi and Martens 1991). Juvenile salmonids tend to avoid streams that are chronically turbid, such as glacial streams or those disturbed by human activities, except when the fish must traverse these streams along migration routes (Lloyd *et al*. 1987). In addition, a potential positive effect is providing refuge and cover from predation (Gregory and Levings 1998).

Fish that remain in turbid, or elevated TSS, waters experience a reduction in predation from piscivorous fish and birds (Gregory and Levings 1998). In habitats with intense predation pressure, this provides a beneficial trade-off (e.g., enhanced survival) to the cost of potential physical effects (e.g., reduced growth). Turbidity levels of about 23 Nephalometric Turbidity Units (NTU) have been found to minimize bird and fish predation risks (Gregory 1993). Exposure duration is a critical determinant of the occurrence and magnitude of physical or behavioral effects (Newcombe and MacDonald 1991). Salmonids have evolved in systems that periodically experience short-term pulses (days to weeks) of high suspended sediment loads, often associated with floods, and are adapted to such high pulse exposures. Adult and larger juvenile salmonids appear to be little affected by the high concentrations of suspended sediments that occur during storm and snowmelt runoff episodes (Bjorn and Reiser 1991). However, chronic exposure can cause physiological stress that can increase maintenance energy and reduce feeding and growth (Redding *et al*. 1987, Lloyd 1987, Servizi and Martens 1991).

Turbidity, at moderate levels, has the potential to adversely affect primary and secondary productivity, and at high levels, has the potential to injure and kill adult and juvenile fish, and may also interfere with feeding (Spence *et al.* 1996). Newly emerged salmonid fry may be vulnerable to even moderate amounts of turbidity (Bjornn and Reiser 1991). Other behavioral effects on fish, such as gill flaring and feeding changes, have been observed in response to pulses of suspended sediment (Berg and Northcote 1985). Fine redeposited sediments also have the potential to adversely affect primary and secondary productivity (Spence *et al.* 1996), and to reduce incubation success (Bell 1991) and cover for juvenile salmonids (Bjornn and Reiser 1991).

The adverse affects associated with the proposed pile driving (noise and turbidity), barge use, and contamination from treated wood piles will be minimal due to the reduced presence of listed salmonids in the project area during the proposed action, the removal of treated wood piles, and the use of steel piles.

Dredging

Dredging and disposal of the dredged material speed up the natural processes of sediment erosion, transportation and deposition (Morton 1977). The physical effects to the river system from dredging and disposal briefly summarized are: temporary increases in turbidity, changes in bottom topography with resultant changes in water circulation, and changes in the mechanical properties of the sediment at the dredge and disposal sites (Nightingale and Simenstad 2001, Hershman 1999, Morton 1977). The significance of the effect is a function of the ratio of the size of the dredged area to the size of the bottom area and water volume (Morton 1977).

Potential effects to listed salmonids from the proposed action include both direct and indirect effects. Potential direct effects include entrainment of juvenile fish (Nightingale and Simenstad 2001, Armstrong *et al.* 1982, Tutty 1976, Dutta and Sookachoff 1975a, Boyd 1975) and mortality from exposure to suspended sediments (turbidity) (Nightingale and Simenstad 2001). Potential indirect effects include behavioral and sub-lethal affects from exposure to increased turbidity (Nightingale and Simenstad 2001, Emmett *et al.* 1988, Gregory 1988, Servizi 1988, Sigler 1988, Kirn *et al.* 1986, Berg and Northcote 1985, Sigler *et al*. 1984, Whitman *et al*. 1982); mortality from predatory species associated with dredged material disposal (Nightingale and Simenstad 2001); mortality resulting from stranding as a result of vessel wakes; modifications to nearshore habitat resulting from erosion as a result of vessel wakes or dredging itself (Nightingale and Simenstad 2001); loss of benthic food sources resulting from dredging and disposal of dredged material (Nightingale and Simenstad 2001, Morton 1977); and cumulative effects of increased industrialization at port facilities located along the river.

The proposed hydraulic suction dredging may entrain juvenile salmonids. When juvenile salmonids come within the “zone of influence” of the cutter head, they may be drawn into the suction pipe (Dutta 1976, Dutta and Sookachoff 1975a). Dutta (1976) reported that salmon fry were entrained by suction dredging in the Fraser River and that suction dredging during juvenile migration should be controlled. Almost 99% of entrained juveniles were killed in studies by Braun (1974a, 1974b). Suction dredging operations caused “a partial destruction of the anadromous salmon fishery resource of the Fraser River” (Dutta and Sookachoff 1975b). Suction pipeline dredges operating in the Fraser River during fry migration took substantial numbers of juveniles (Boyd 1975). As a result of these studies, the Canadian government issued dredging guidelines for the Fraser River to minimize the potential for entrainment (Boyd 1975). Further testing in 1980 by Arseneault (1981) found entrainment of chum and pink salmon but in low numbers relative to the total of salmonids outmigrating (0.0001 to 0.0099%).

The Corps' Portland District conducted extensive sampling within the Columbia River in 1985-88 (Larson and Moehl 1990) and again in 1997 and 1998. In the 1985-88 study no juvenile salmon were entrained and the 1997-98 study resulted in entrainment of only two juvenile salmon. Examination of fish entrainment rates in Grays Harbor from 1978 to 1989 detected only one juvenile salmon entrained (McGraw and Armstrong 1990). Dredging was conducted outside peak migration times. No evidence of fish mortality was found while monitoring dredging activities along the Atlantic Intracoastal Waterway (Stickney 1973).

These Fraser and Columbia River studies examined deep-water areas associated with main channels. There is little information on the extent of entrainment in shallow water areas, such as those associated with the proposed action. Further information is needed to determine if suction dredging in these shallow water areas may entrain juvenile salmonids.

In areas of coarse sand, NMFS expects the turbidity generated from the dredging process to be very small and confined to the area close to the cutterhead. In areas of fine and medium-grained sediments, turbidity and resuspension of toxic sediments during dredging and disposal may be a problem. The sediment test results from a 1997 sample event in the mooring basin indicate a high percentage of silt/clay in the composite sample-A (97.3% to 98.4%). The silt/clay percentage for composite sample-B was considerably less (56.3%). The sampling protocol prevents determining which composite more accurately represents the sediments in the proposed dredge area. Also, records are insufficient to identify which composite contained samples from the sites located in the proposed dredging area. Therefore, NMFS must assume the sediments contain a high silt/clay percentage as suggested by sample-A, and that considerable turbidity may result from the proposed dredging and in water disposal.

Turbidity effects have been discussed above under *Breakwater Construction and Removal*. Issues involving turbidity associated with flow-lane disposal were addressed in previous biological opinions with the Corps for navigation channel maintenance dredging (NMFS 1993, NMFS 1999). NMFS did not believe that mortality resulting from turbidity was an issue of concern during those consultations and has no information that would change that belief for this Opinion. While further study is warranted on shallow water habitat dredging, current information suggests the size of the proposed action will limit any adverse effects to a low level of incidence at the dredge site. The proposed timing (November 1 to February 28) and methodology restraints (hydraulic dredging and ebbtide disposal) should minimize turbidity exposure to at-risk juvenile life stage salmonids. Adult salmonids (e.g., steelhead, chum salmon, and coho salmon) are expected to avoid the turbidity plume.

The sediment test results suggest that the material to be dredged from the West Mooring Basin does not exceed current DMMT contaminant screening levels and is suitable for in-water disposal. Regardless of the DMMT determination, the NMFS has ongoing concerns about the potential effects of sediment contaminants, particularly sublethal and cumulative effects. Direct and indirect adverse effects may be exhibited at very low concentrations for some contaminants

(Brewer *et al*. 2001, Moore and Waring 2001, Beauvais *et al*. 2000, Johnson 2000, Scholz *et al*. 2000, NMFS 1998, Warring and Moore 1997, Zuranko *et al*. 1997, Moore and Warring 1996, Meador 1991). Sediment test results submitted by the Corps for the proposed action indicate elevated concentrations of tributyltin (TBT) and polycyclic aromatic hydrocarbon (PAH); however, no contaminate concentrations exceed the threshold levels that NMFS considers harmful.[2]

Dredged material disposed of in the flow lane will not collect at the point of discharge, but will be transported in the lower water column and be distributed over a large area. Eventually, dredged material will be transported out to sea by river currents and natural bedload transport. Therefore, the effects of flow-lane disposal may extend well downstream. Any adverse effects presumably will diminish the further downstream the material is transported and dispersed.

The dredging and dredged material disposal activity associated with the proposed action may result in direct effects on listed species. These effects will likely be minimal due to the relative low abundance of listed salmonids in the project area during the proposed action and the expanse of the channel. Furthermore, flow-lane disposal at a depth of 35 feet during ebb tides is expected to reduce water column effects.

Construction Equipment

As with all construction activities, accidental release of fuel, oil, and other contaminants may occur. Operation of the pile drivers, backhoes, and other equipment requires the use of fuel, lubricants, etc., which if spilled into the channel of a water body or into the adjacent riparian zone could injure or kill aquatic organisms. Petroleum-based contaminants (such as fuel, oil, and some hydraulic fluids) contain PAHs which can cause acute toxicity to salmonids at high levels of exposure and can also cause chronic lethal as well as acute and chronic sublethal effects to aquatic organisms (Neff 1985).

1.5.2 Effects on Critical Habitat

The NMFS designates critical habitat based on physical and biological features that are essential to the listed species. Essential features of designated critical habitat include substrate, water quality, water quantity, water temperature, food, riparian vegetation, access, water velocity, space and safe passage. Effects to critical habitat from these categories are included in the effects description expressed above in section 1.5.1, *Effects of Proposed Action*.

1.5.3 Cumulative Effects

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[2] E-mail message from Dr. James Meader, NMFS' Northwest Fisheries Science Center, to Rob Markle, NMFS, Oregon Habitat Branch, discussing a review of the sediment test results for the West Mooring Basin Breakwater Reconstruction Project (September 24, 2001).

Cumulative effects are defined in 50 CFR 402.02 as those effects of "future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area. Cumulative effects are defined in 50 CFR 402.02 as those effects of "future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation." Future Federal actions, including the ongoing operation of hydropower systems, hatcheries, fisheries, and land management activities are being (or have been) reviewed through separate section 7 consultation processes. Therefore, these actions are not considered cumulative to the proposed action.

The NMFS is not aware of any specific future non-Federal activities within the action area that would cause greater affects to listed species than presently occurs. The NMFS assumes that future private and state actions will continue at similar intensities as in recent years. As the human population in the state continues to grow, it is foreseeable that demand for actions similar to the subject project will continue to increase as well. Each subsequent action by itself may have only a small incremental effect, but taken together they may be expected to have a significant effect that would further degrade the watershed’s environmental baseline and undermine the improvements in habitat conditions necessary for listed species to survive and recover.

1.6 Conclusion

After reviewing the current status of the listed species, the environmental baseline for the action area, the effects of the proposed breakwater reconstruction, associated dredging and disposal, and cumulative effects, NMFS has determined that the West Mooring Basin Breakwater Reconstruction Project, as proposed, is not likely to jeopardize the continued existence of Snake River steelhead, Upper Columbia River steelhead, Middle Columbia River steelhead, Upper Willamette River steelhead, Lower Columbia River steelhead, Snake River spring/summer chinook salmon, Snake River fall chinook salmon, Upper Columbia River spring-run chinook salmon, Upper Willamette River chinook salmon, Lower Columbia River chinook salmon, Columbia River chum salmon, or Snake River sockeye salmon, and is not likely to destroy or adversely modify designated critical habitat for these ESUs. This finding is based, in part, on incorporation of best management practices (BMPs) into the proposed project design (e.g., ODFW in-water work window, use of steel pile, and removal of treated wood), but also on the following considerations: (1) Testing indicates sediment contaminates are below known harmful thresholds, and dredging and in-water disposal will not pose an undue risk of exposure; (2) dredging will occur when listed species are present in relatively low numbers and the risk of entrainment is reduced; and (3) the period of dredged material disposal will occur when listed species are present in relatively low numbers and background turbidity levels are already elevated.

1.7 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Conservation recommendations are discretionary measures suggested to minimize or avoid adverse effects of a proposed action on listed species, to minimize or avoid adverse modification of critical habitats, or to develop additional information. The NMFS believes the following conservation recommendations are consistent with these obligations, and therefore should be carried out by the Corps for lower Columbia River dredging activities conducted under Corps authorization:

1. As previously recommended (NMFS 1999), the Corps should analyze potential dredge entrainment of juvenile salmonids in shallow water areas maintained by the Corps, and send NMFS a copy of that analysis by January 2002.

2. The Corps should reassess the potential effects of contaminants, including sublethal effects and bioaccumulation, on fish and benthic prey species from in-water disposal of dredged materials.

In order for the NMFS to be kept informed of actions minimizing or avoiding adverse effects, or those that benefit listed salmon and their habitats, NMFS requests notification of any actions leading to the achievement of these conservation recommendations.

1.8 Reinitiation of Consultation

This concludes formal consultation on these actions in accordance with 50 CFR 402.14(b)(1). Reinitiation of consultation is required: (1) If the amount or extent of incidental take is exceeded; (2) the action is modified in a way that causes an effect on the listed species that was not previously considered in the biological assessment and this Opinion; (3) new information or project monitoring reveals effects of the action that may affect the listed species in a way not previously considered; or (4) a new species is listed or critical habitat is designated that may be affected by the action (50 CFR 402.16).

2. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered species and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct. Harm is further defined by NMFS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, and sheltering (50 CFR 217.12). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to, and not intended as part of, the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the term and conditions of this Incidental Take Statement.

2.1 Amount or Extent of Take

The NMFS anticipates that the proposed action covered by this Opinion has more than a negligible likelihood of incidental take of listed species resulting from breakwater removal, pile driving, dredging, and in-river disposal of dredged material. Effects of actions such as these are largely unquantifiable in the short term, but are expected to be largely limited to non-lethal take in the form of behavior modification. The effects of these activities on population levels are also largely unquantifiable and not expected to be measurable in the long term.

Therefore, even though NMFS expects some low level of non-lethal incidental take to occur due to the action covered by this Opinion, the best scientific and commercial data available are not sufficient to enable NMFS to estimate a specific amount of incidental take to the species themselves. In instances such as this, NMFS designates the expected level of take in terms of the extent of take allowed. Therefore, NMFS limits the area of allowable incidental take during construction to that aquatic area within 1,000 foot of the breakwater, and during dredge material disposal to a 3-mile reach of the Columbia River. Incidental take occurring beyond these areas is not authorized by this consultation.

2.2 Reasonable and Prudent Measures

The NMFS believes that the following reasonable and prudent measures are necessary and appropriate to minimize take of the above species.

1. Minimize the likelihood of incidental take associated with in-water structures by applying permit conditions to deter piscivorous birds.

2. Minimize the likelihood of incidental take associated with in-water construction, dredging and dredged material disposal by applying permit conditions to avoid or minimize disturbance to riparian and aquatic systems.

3. Ensure this biological opinion is meeting its objective of minimizing the likelihood of take from permitted activities by requiring comprehensive monitoring and reporting.

2.3 Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, Corps must comply with the following terms and conditions, which implement the reasonable and prudent measures described above for each category of activity.

4. To Implement Reasonable and Prudent Measure #1 above, the Corps shall ensure that:
    a. Piscivorous bird deterrence. An effort will be made to develop and install a device that will minimize perching by piscivorous birds on the new breakwater by August 31, 2002.

5. To Implement Reasonable and Prudent Measure #2 (monitoring and reporting), the Corps shall ensure that:
    a. Prohibited actions. No preboring or jetting shall occur.
    b. In-water work.
        i. All work shall take place during the recommended ODFW in-water work period (November 1 to February 28).
        ii. No in-water work shall take place outside the ODFW in-water work period without prior written authorization from the Corps (in consultation with NMFS).
    c. Pollution Control.
        i. A Pollution Control Plan (PCP) is developed to prevent point-source pollution related to construction operations that satisfies all pertinent requirements of Federal, State and local laws and regulations, and the requirements of these conservation measures.
        ii. An oil absorbing, floating boom shall be available on-site during all phases of construction.
    d. Hydraulic dredge operation.
        i. When using a hydraulic dredge, the dredge intake must be operated at or below the surface of the material being removed, but may be raised a maximum of three feet above the bed for brief periods of purging or flushing. At no time shall the dredge be operated at a level higher than three feet above the bed.
        ii. The discharge pipe shall be placed deeper than 20 feet below the surface during flow-lane disposal.

6. To Implement Reasonable and Prudent Measure #3 (monitoring and reporting), the Corps shall ensure that:
    a. Within 30 days of completing the project, the applicant will submit a monitoring report to the Corps and NMFS describing the applicant's success meeting their permit conditions. This report will consist of the following information.
        i. Project identification.
            (1) Permit number;
            (2) applicant’s name;
            (3) project name;
            (4) project location by 5th field hydrological unit code (HUC) and latitude and longitude;
            (5) starting and ending dates for work performed under the permit; and

(6) the Corps contact person.

ii. A summary of the downstream extent and duration of any turbidity plume, efforts made to control them.

iii. A copy of the pollution control inspection reports, a description of any accidental spills of hazardous materials, and efforts made to control accidental spills.

iv. A copy of the supporting analysis of environmentally acceptable alternatives for management of the dredged material, if not previously provided.

v. Photographic documentation of environmental conditions at the project site before, during and after project completion.

(1) Photographs will include general project location views and close-ups showing details of the project area and project, including pre and post construction.

(2) Each photograph will be labeled with the date, time, photo point, project name, the name of the photographer, and a comment describing the photograph's subject.

(3) Relevant habitat conditions include characteristics of water quality and other visually discernible environmental conditions at the project area, and upstream and downstream of the project.

b. By August 31, 2002, the applicant will submit a monitoring report to the Corps and NMFS describing the applicant's efforts to deter perching of piscivorous birds on the breakwater. This report will consist of the following information.

i. Description of anti-perching device installed on breakwater.

ii. Date of device installation.

iii. Photographs of device.

iv. An evaluation of device effectiveness to deter perching.

c. The monitoring report shall be submitted to:

National Marine Fisheries Service
Habitat Conservation Division
Attn: OSB2001-0056-FEC
525 NE Oregon Street, Suite 500
Portland, OR 97232

d. If a dead, injured, or sick endangered or threatened species specimen is located, initial notification must be made to the National Marine Fisheries Service Law Enforcement Office, at the Vancouver Field Office, 600 Maritime, Suite 130, Vancouver, Washington 98661; phone: 360.418.4246. Care should be taken in handling sick or injured specimens to ensure effective treatment and care or the handling of dead specimens to preserve biological material in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured endangered and threatened species or preservation of biological materials from a dead animal, the finder has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not disturbed.

3. MAGNUSON-STEVENS ACT

3.1 Background

On July 18, 2001, the NMFS received a letter from the Corps requesting Essential Fish Habitat (EFH) consultation for the subject action pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) and its implementing regulations (50CFR600). The objective of the EFH consultation is to determine whether the proposed action may adversely affect designated EFH for relevant species, and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH resulting from the proposed action.

3.2 Magnuson-Stevens Fishery Conservation and Management Act

The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-297), requires the inclusion of EFH descriptions in Federal fishery management plans. In addition, the MSA requires Federal agencies to consult with NMFS on activities that may adversely affect EFH.

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). For the purpose of interpreting the definition of essential fish habitat: Waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities; necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and “spawning, breeding, feeding, or growth to maturity” covers a species' full life cycle (50CFR600.110).

Section 305(b) of the MSA (16 U.S.C. 1855(b)) requires that:

- Federal agencies must consult with NMFS on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH;
- NMFS shall provide conservation recommendations for any Federal or State activity that may adversely affect EFH;
- Federal agencies shall within 30 days after receiving conservation recommendations from NMFS provide a detailed response in writing to NMFS regarding the conservation recommendations. The response shall include a description of measures proposed by the

agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the conservation recommendations of NMFS, the Federal agency shall explain its reasons for not following the recommendations.

The MSA requires consultation for all actions that may adversely affect EFH, and does not distinguish between actions within EFH and actions outside EFH. Any reasonable attempt to encourage the conservation of EFH must take into account actions that occur outside EFH, such as upstream and upslope activities, that may have an adverse effect on EFH. Therefore, EFH consultation with NMFS is required by Federal agencies undertaking, permitting or funding activities that may adversely affect EFH, regardless of their locations.

3.3 Identification of EFH

The Pacific Fisheries Management Council (PFMC) has designated EFH for federally-managed fisheries within the waters of Washington, Oregon, and California. The designated EFH for groundfish and coastal pelagic species encompasses all waters from the mean high water line, and upriver extent of saltwater intrusion in river mouths, along the coasts of Washington, Oregon and California, seaward to the boundary of the U.S. exclusive economic zone (200 miles) (PFMC 1998a, 1998b). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently, or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable man-made barriers (as identified by the PFMC), and longstanding, naturally-impassable barriers (e.g., natural waterfalls in existence for several hundred years) (PFMC 1999). In estuarine and marine areas, designated salmon EFH extends from the nearshore and tidal submerged environments within state territorial waters out to the full extent of the exclusive economic zone offshore of Washington, Oregon, and California north of Point Conception to the Canadian border.

Detailed descriptions and identifications of EFH for the groundfish species are found in the Final Environmental Assessment/Regulatory Impact Review for Amendment 11 to The Pacific Coast Groundfish Management Plan (PFMC 1998a) and the NMFS Essential Fish Habitat for West Coast Groundfish Appendix (Casillas *et al.* 1998). Detailed descriptions and identifications of EFH for the coastal pelagic species are found in Amendment 8 to the Coastal Pelagic Species Fishery Management Plan (PFMC 1998b). Detailed descriptions and identifications of EFH for salmon are found in Appendix A to Amendment 14 to the Pacific Coast Salmon Plan (PFMC 1999). Assessment of the potential adverse effects to these species' EFH from the proposed action is based on this information.

3.4 Proposed Actions

The proposed actions are detailed above in Section 1.2 of this document. The action area includes a 1.25 acre area at Astoria's East Mooring Basin and an estimated 3 mile reach of the Columbia River from river mile 10 to river mile 13. This area has been designated as EFH for various life stages of numerous groundfish, coastal pelagic fish, and salmon species (Table 2).

3.5 Effects of Proposed Action

As described in detail in Section 1.5 of this document, the proposed activities may result in detrimental short- and long-term adverse effects to a variety of habitat parameters. These impacts include:

Effect #1: Predation - The breakwater may increase the risk of predation by piscivorous birds. The structure will provide an elevated perching platform from which piscivorous birds can launch feeding forays.

Effect #2: Entrainment - Dredging may entrain and kill fish and other species, including prey species, present in the work area.

Effect #3: Turbidity - Flow-lane disposal of dredge material will expose species present in the channel to elevated turbidity. An increase in turbidity can harm fish and filter-feeding macro-invertebrates.

Effect #4: Noise - Activities associated with pile driving have the potential to disrupt normal fish behavior. For example, salmonids can detect sound frequencies generated by pile driving within a radius of 984 feet (Feist *et al*. 1996), and may be displaced by the disturbance.

Effect #5: Chemical Contamination - As with all construction activities, accidental release of fuel, oil, and other contaminants may occur.

3.6 Conclusion

NMFS believes that the proposed action may adversely affect the EFH for the groundfish, coastal pelagic, and Pacific salmon species listed in Table 2.

3.7 EFH Conservation Recommendations

Pursuant to section 305(b)(4)(A) of the Magnuson-Stevens Act, NMFS is required to provide EFH conservation recommendations for any Federal or state agency action that would adversely affect EFH. The conservation measures proposed for the project by the Corps, all Conservation Recommendations outlined above in Section 1.7 and all of the Reasonable and Prudent Measures and the Terms and Conditions contained in Sections 2.2 and 2.3 are applicable to salmon EFH. Therefore, NMFS incorporates each of those measures here as EFH conservation recommendations.

3.8 Statutory Response Requirement

Please note that the Magnuson-Stevens Act (section 305(b)) and 50 CFR 600.920(j) requires the Federal agency to provide a written response to NMFS after receiving EFH conservation recommendations within 30 days of its receipt of this letter. This response must include a description of measures proposed by the agency to avoid, minimize, mitigate or offset the adverse impacts of the activity on EFH. If the response is inconsistent with a conservation recommendation from NMFS, the agency must explain its reasons for not following the recommendation.

3.9 Consultation Renewal

The Corps must reinitiate EFH consultation with NMFS if either action is substantially revised or new information becomes available that affects the basis for NMFS' EFH conservation recommendations (50 CFR 600.920).

Table 1. References for additional background on listing status, biological information, protective regulations, and critical habitat elements for the ESA listed species present in the lower Columbia River.

Species	Listing Status	Critical Habitat	Protective Regulations	Biological Information, Historical Population Trends
Columbia River chum salmon	March 25, 1999; 64 FR 14508, Threatened	February 16, 2000; 65 FR 7764	July 10, 2000; 65 FR 42422	Johnson *et al.* 1997; Salo 1991
Lower Columbia River steelhead	March 19, 1998; 63 FR 13347, Threatened	February 16, 2000; 65 FR 7764	July 10, 2000; 65 FR 42422	Busby *et al.* 1995; 1996
Middle Columbia River steelhead	March 25, 1999; 64 FR 14517, Threatened	February 16, 2000; 65 FR 7764	July 10, 2000; 65 FR 42422	Busby *et al.* 1995; 1996
Upper Columbia River steelhead	August 18, 1997; 62 FR 43937, Endangered	February 16, 2000; 65 FR 7764	ESA section 9 take prohibition applies	Busby *et al.* 1995; 1996
Upper Willamette River steelhead	March 24, 1999 64 FR 14517, Threatened	February 16, 2000; 65 FR 7764	July 10, 2000; 65 FR 42422	Busby *et al.* 1995; 1996
Snake River Basin steelhead	August 18, 1997; 62 FR 43937, Threatened	February 16, 2000; 65 FR 7764	July 10, 2000; 65 FR 42422	Busby *et al.* 1995; 1996
Snake River sockeye salmon	November 20, 1991; 56 FR 58619, Endangered	December 28, 1993; 58 FR 68543	ESA section 9 take prohibition applies	Waples *et al.* 1991a; Burgner 1991
Lower Columbia River chinook salmon	March 24, 1999; 64 FR 14308, Threatened	February 16, 2000; 65 FR 7764	July 10, 2000; 65 FR 42422	Myers *et al.*1998; Healey 1991
Upper Columbia River spring-run chinook salmon	March 24, 1999; 64 FR 14308, Endangered	February 16, 2000; 65 FR 7764	ESA section 9 take prohibition applies	Myers *et al.*1998; Healey 1991
Upper Willamette River chinook salmon	March 24, 1999; 64 FR 14308, Threatened	February 16, 2000; 65 FR 7764	July 10, 2000; 65 FR 42422	Busby *et al.* 1995; 1996
Snake River spring/summer-run chinook salmon	April 22, 1992; 57 FR 14653, Threatened	December 28, 1993; 58 FR 68543	April 22, 1992; 57 FR 14653	Matthews and Waples 1991; Healey 1991
Snake River fall chinook salmon	April 22, 1992; 57 FR 14653, Threatened	December 28, 1993; 58 FR 68543	April 22, 1992; 57 FR 14653	Waples *et al.* 1991b; Healey 1991
Lower Columbia River/ Southwest WA coho salmon	July 25, 1995; 60 FR 38011, Candidate	Not applicable	Not applicable	Weitkamp *et al.* 1995

Table 2. Species with designated EFH found in waters of the State of Oregon.

Ground Fish Species	Blue rockfish (*S. mystinus*)	Rougheye rockfish (*S. aleutianus*)	Flathead sole (*Hippoglossoides elassodon*)
Leopard shark (*Triakis semifasciata*)	Bocaccio (*S. paucispinis*)	Sharpchin rockfish (*S. zacentrus*)	Pacific sanddab (*Citharichthys sordidus*)
Soupfin shark (*Galeorhinus zyopterus*)	Brown rockfish (*S. auriculatus*)	Shortbelly rockfish (*S. jordani*)	Petrale sole (*Eopsetta jordani*)
Spiny dogfish (*Squalus acanthias*)	Canary rockfish (*S. pinniger*)	Shortraker rockfish (*S. borealis*)	Rex sole (*Glyptocephalus zachirus*)
Big skate (*Raja binoculata*)	Chilipepper (*S. goodei*)	Silvergray rockfish (*S. brevispinus*)	Rock sole (*Lepidopsetta bilineata*)
California skate (*R. inornata*)	China rockfish (*S. nebulosus*)	Speckled rockfish (*S. ovalis*)	Sand sole (*Psettichthys melanostictus*)
Longnose skate (*R. rhina*)	Copper rockfish (*S. caurinus*)	Splitnose rockfish (*S. diploproa*)	Starry flounder (*Platyichthys stellatus*)
Ratfish (*Hydrolagus colliei*)	Darkblotched rockfish (*S. crameri*)	Stripetail rockfish (*S. saxicola*)	
Pacific rattail (*Coryphaenoides acrolepsis*)	Grass rockfish (*S. rastrelliger*)	Tiger rockfish (*S. nigrocinctus*)	**Coastal Pelagic Species**
Lingcod (*Ophiodon elongatus*)	Greenspotted rockfish (*S. chlorostictus*)	Vermillion rockfish (*S. miniatus*)	Northern anchovy (*Engraulis mordax*)
Cabezon (*Scorpaenichthys marmoratus*)	Greenstriped rockfish (*S. elongatus*)	Widow Rockfish (*S. entomelas*)	Pacific sardine (*Sardinops sagax*)
Kelp greenling (*Hexagrammos decagrammus*)	Longspine thornyhead (*Sebastolobus altivelis*)	Yelloweye rockfish (*S. ruberrimus*)	Pacific mackerel (*Scomber japonicus*)
Pacific cod (*Gadus macrocephalus*)	Shortspine thornyhead (*Sebastolobus alascanus*)	Yellowmouth rockfish (*S. reedi*)	Jack mackerel (*Trachurus symmetricus*)
Pacific whiting (Hake) (*Merluccius productus*)	Pacific Ocean perch (*S. alutus*)	Yellowtail rockfish (*S. flavidus*)	Market squid (*Loligo opalescens*)
Sablefish (*Anoplopoma fimbria*)	Quillback rockfish (*S. maliger*)	Arrowtooth flounder (*Atheresthes stomias*)	
Aurora rockfish (*Sebastes aurora*)	Redbanded rockfish (*S. babcocki*)	Butter sole (*Isopsetta isolepsis*)	**Salmon**
Bank Rockfish (*S. rufus*)	Redstripe rockfish (*S. proriger*)	Curlfin sole (*Pleuronichthys decurrens*)	Coho salmon (*O. kisutch*)
Black rockfish (*S. melanops*)	Rosethorn rockfish (*S . helvomaculatus*)	Dover sole (*Microstomus pacificus*)	Chinook salmon (*O. tshawytscha*)
Blackgill rockfish (*S. melanostomus*)	Rosy rockfish (*S. rosaceus*)	English sole (*Parophrys vetulus*)	

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